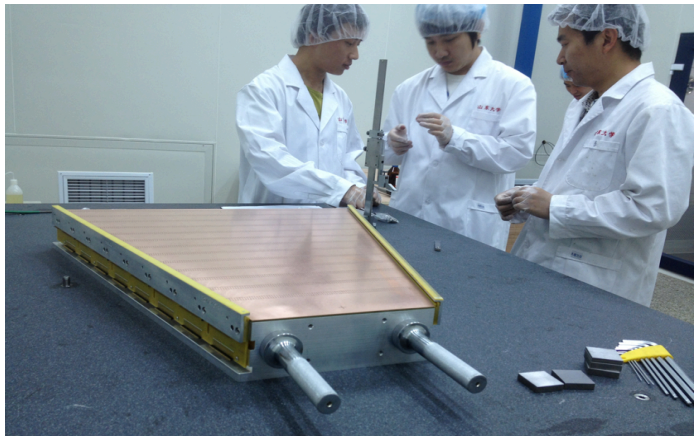
MWPC production plan and resources

Qinghua Xu(Shandong University)

iTPC review, Jan. 25, 2016



Thanks to my colleagues:
Changyu Li, Jian Deng, Peng Lu, Yansheng Sun, Chengguang Zhu,
Xu Wang, Fuwang Shen, Shuai Wang, Chi Yang (USTC)
+ many other iTPC colleagues

Outline:

- Scope of effort with project
- Funding and man-power
- Facilities & laboratory
- Prototype work done
- Time scale of production plan

Scope of effort with project

- Prototype of iTPC sector
- 24 wire plane production
- Assembly of 24 sector (after pcb bonding at LBL)
- Sector test (uniformity, efficiency, linearity)
- Ship the 24 sectors to BNL

Funding & manpower in China for iTPC

- 6.5M RMB (~1M $) support in total from China for MWPC :
  - ✓ 2M RMB from MoST 973 key project for high energy nuclear physics (2014-2018)
  - ✓ 3M RMB from NSFC key project for international cooperation (2016~2020), approved Sep. 2015.
  - ✓ 1.5 M RMB in-kind contribution from Shandong University.
- Manpower & institutions:
  - ✓ SDU: 2 faculties+ 2 engineers + 3 students+2 technician
  - ✓ USTC: 1 professor+1 postdoc
  - ✓ SINAP: 1 professor+1 postdoc

iTPC laboratory at SDU (1)

- New building in 2000 for ATLAS Thin Gap Chamber (TGC). Produced 400 modules of high quality TGC for ATLAS during 1999-2004.
- The lab is ~400m^2 , recently refurbished. New clean room built for iTPC project.
- Cosmic ray test system available for detector test.

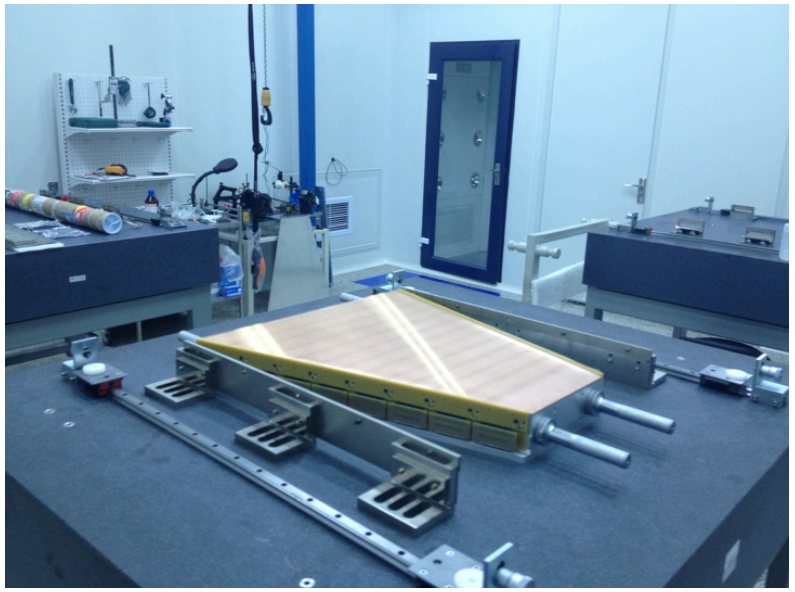
Laboratory hall

Cosmic ray test system

iTPC laboratory at SDU (2)

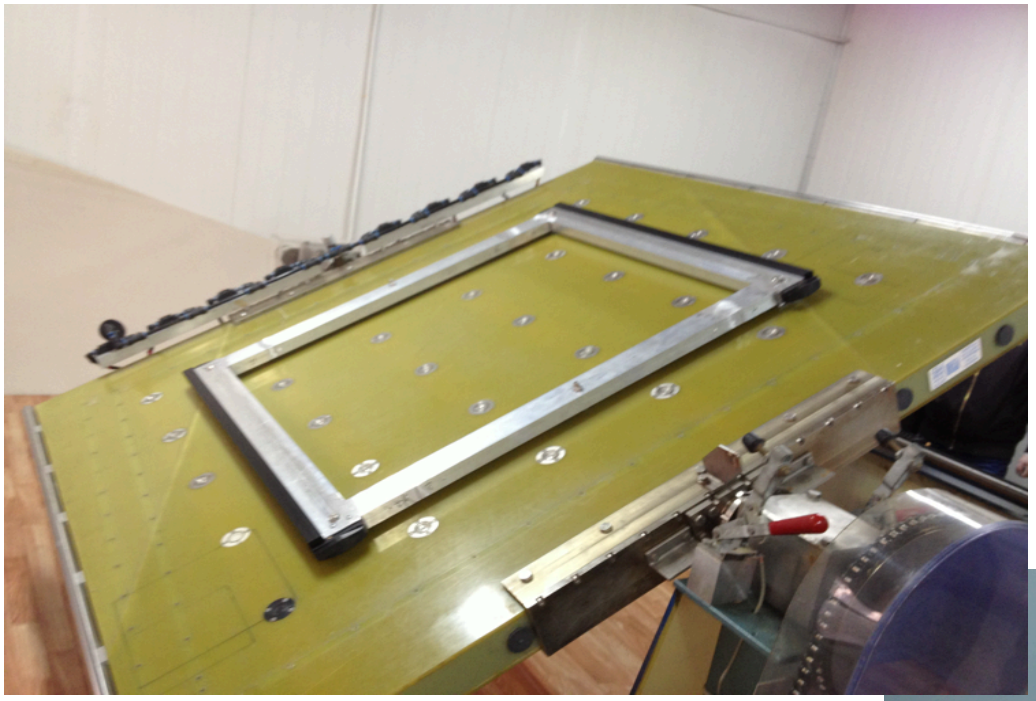
- Wire winding machine imported from Israel.
- 3 new granite tables for sector assembly ready.

Wire pitch and tension controlled by winding machine



Clean room with granite tables (prototyping underway)

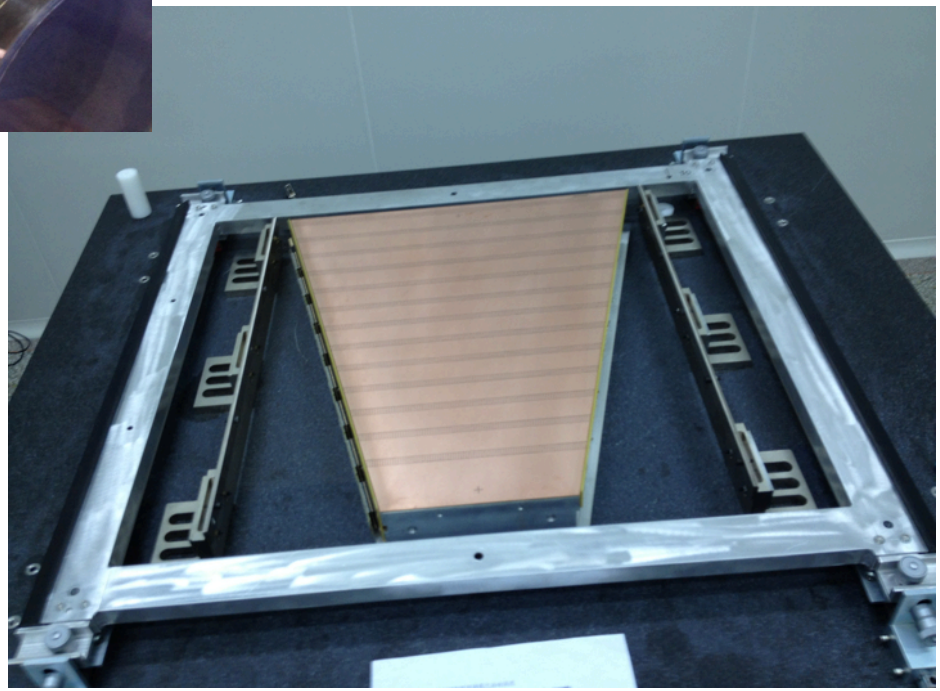
Winding wire on wire frame



Wires first wound on frames

10 wire frames made already,

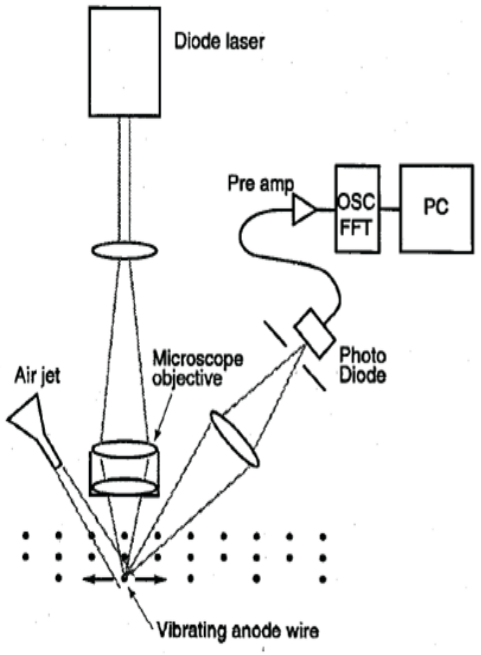
76cm x 90 cm (inner size).

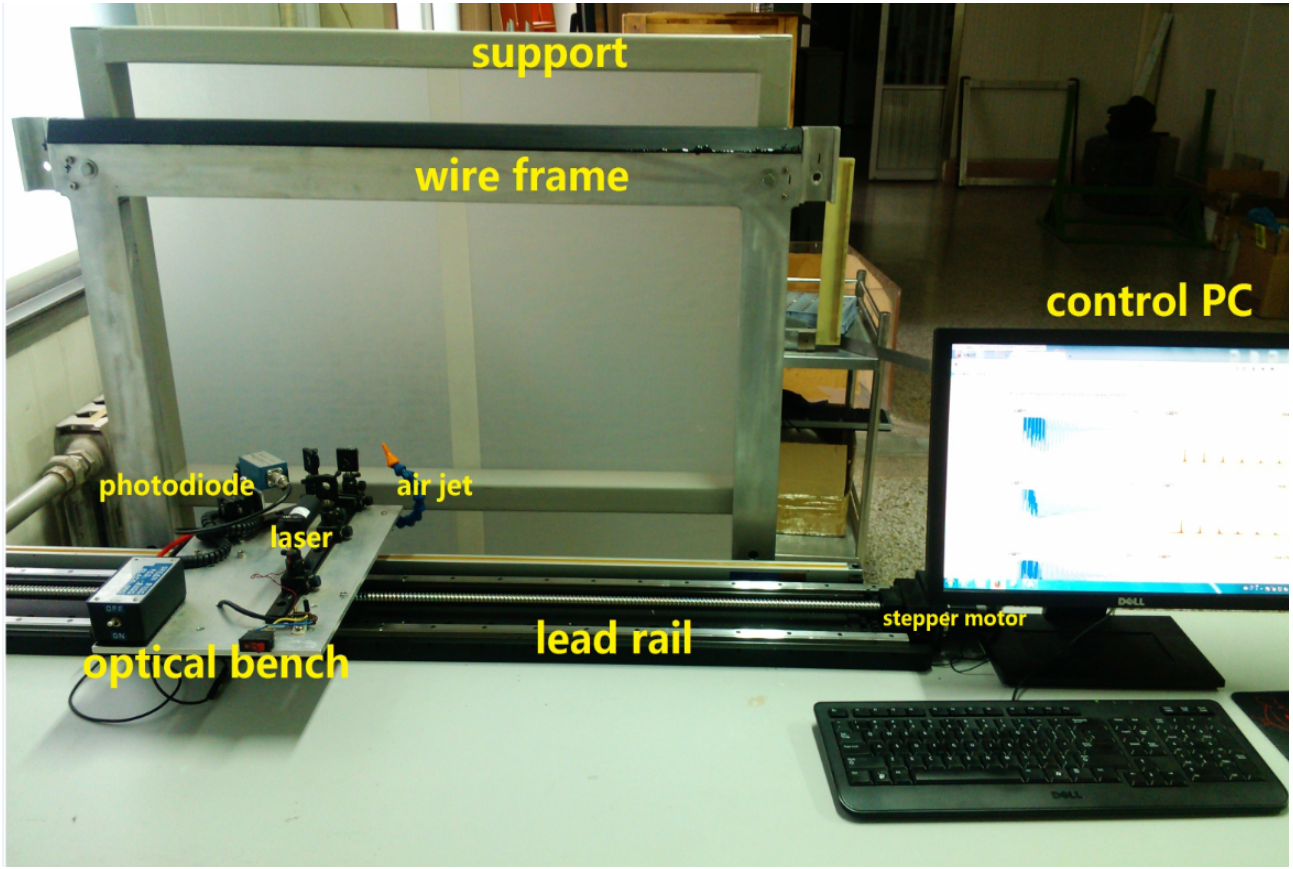


Wire frames will be used for 3 layers of wire plane with wire combs.

Wire tension measurement system

- Determine wire tension by optically measuring the vibration frequency:

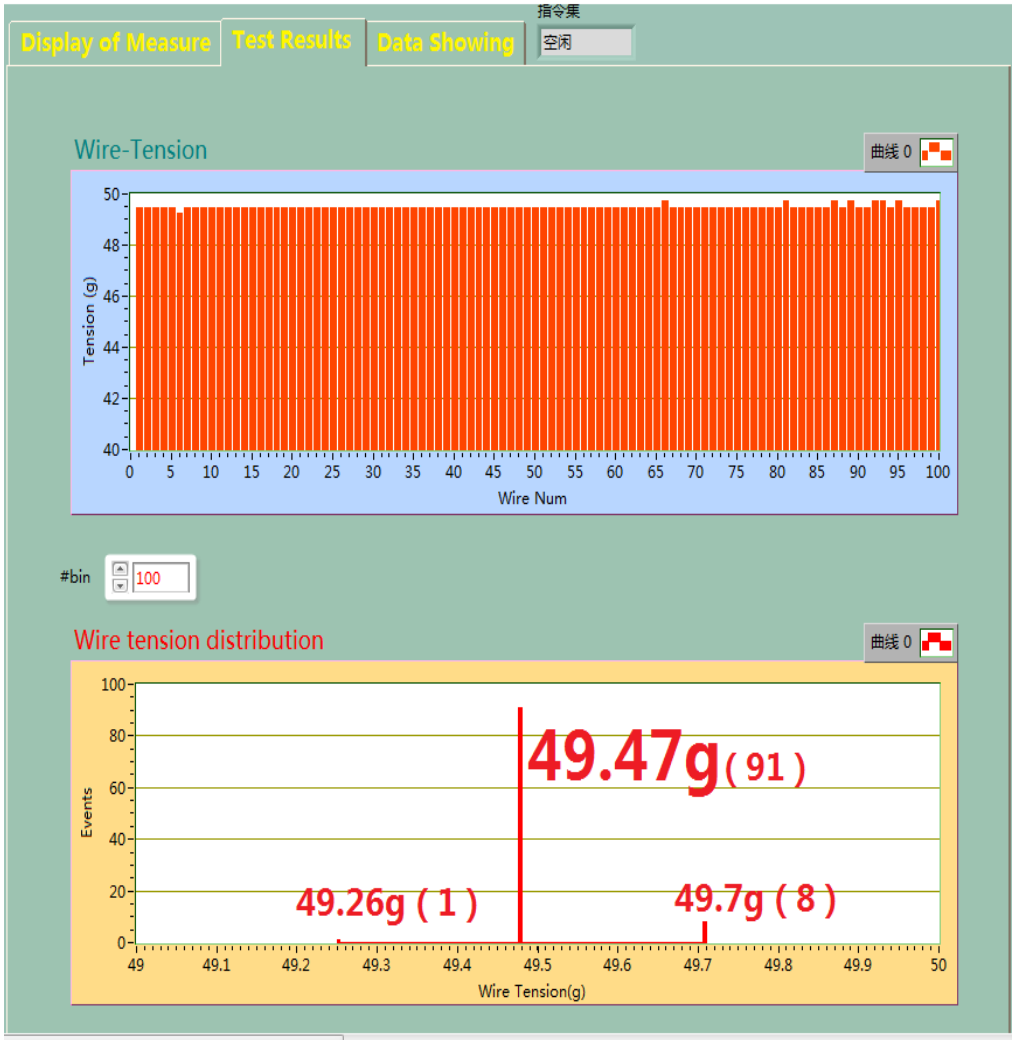


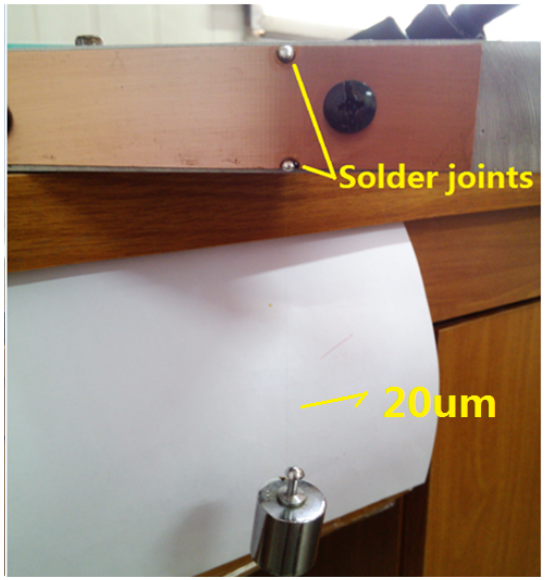


Laser will locate on each wire，synchronized with gas jet, and the base frequency will be extracted from voltage fluctuation transformed of laser absorption.

Wire tension measurement system

- **Cross-check of the method with fixed tension wires:**





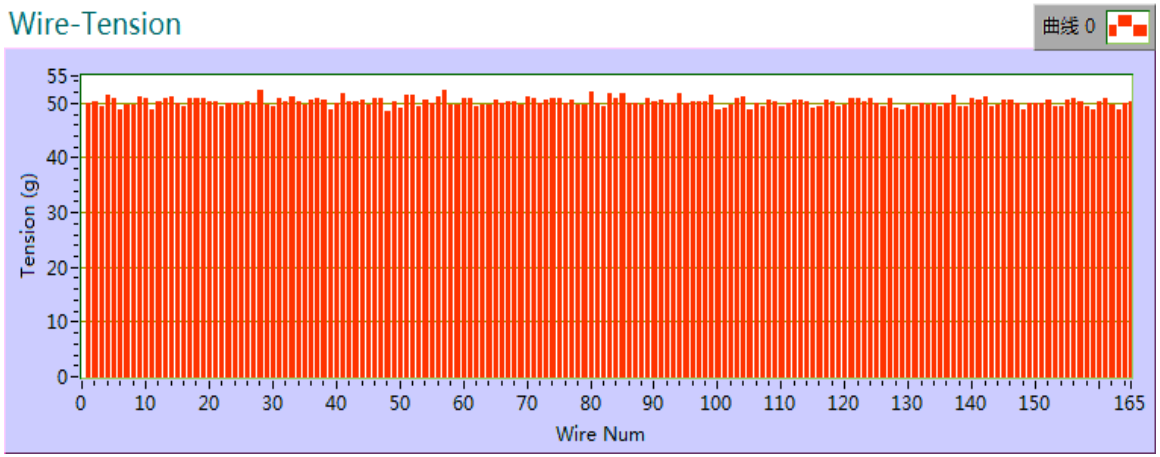
Fixed tension for checks

Measurement with fixed tension: (<2%)

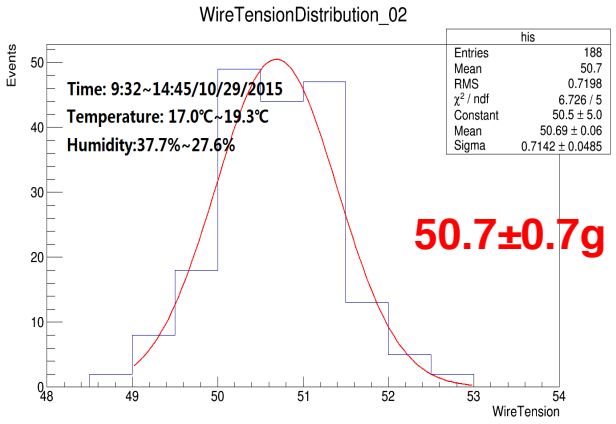
Wires	1	2	3
50g	49.5g	50.8	50.6
60g	60.9	60.6	60.4

Wire tension measurement –Test frame #1 （20um)

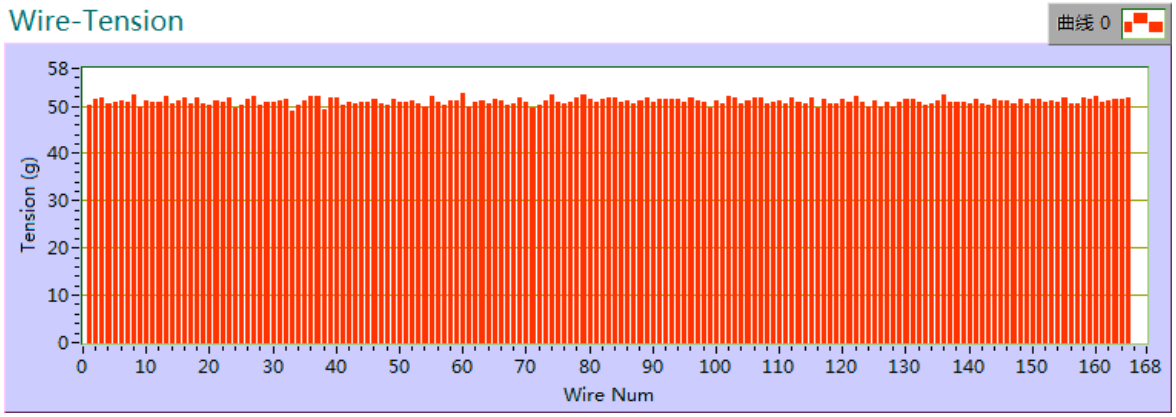
- **Measured tension of 165 wires on wire frame:**

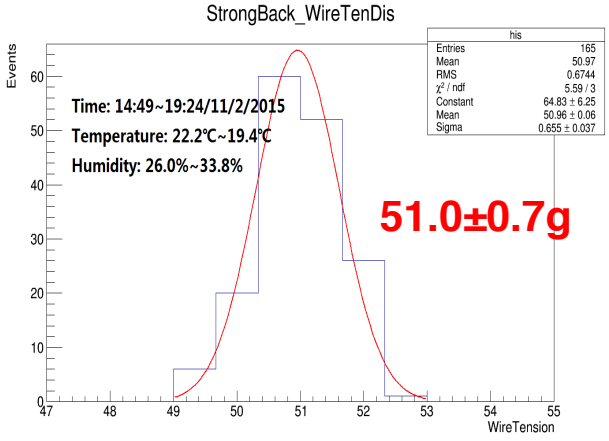


Required to be 51±3g



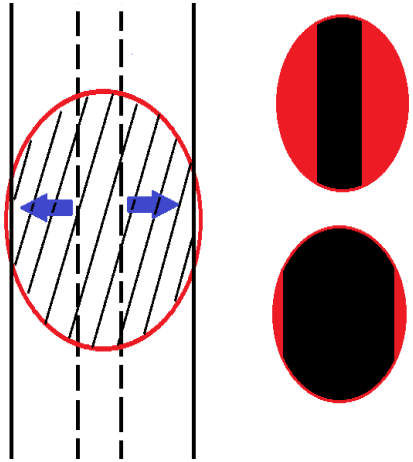
- **Measured tension of 165 wires after glued on anode wire mounts:**

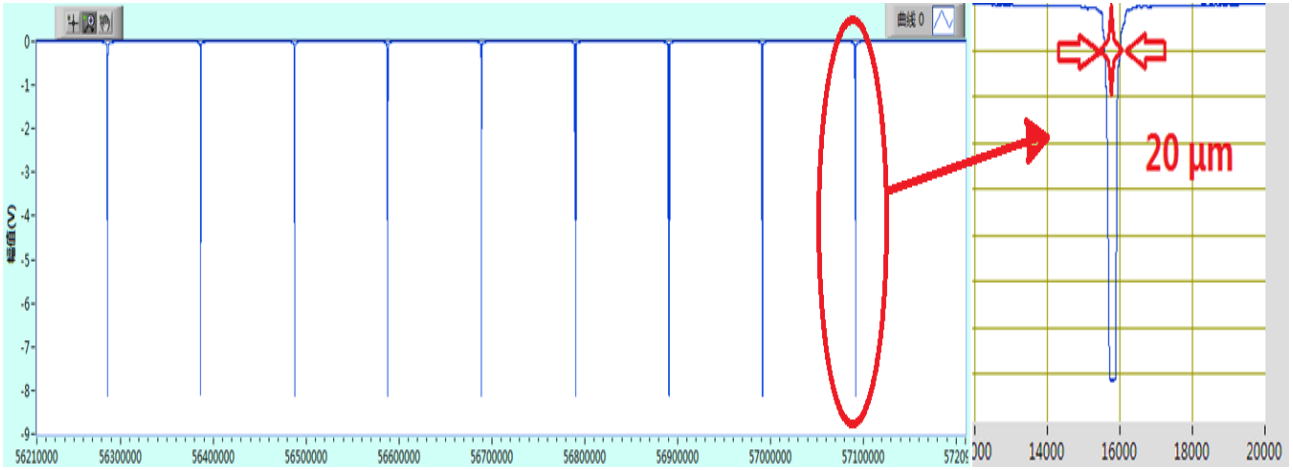




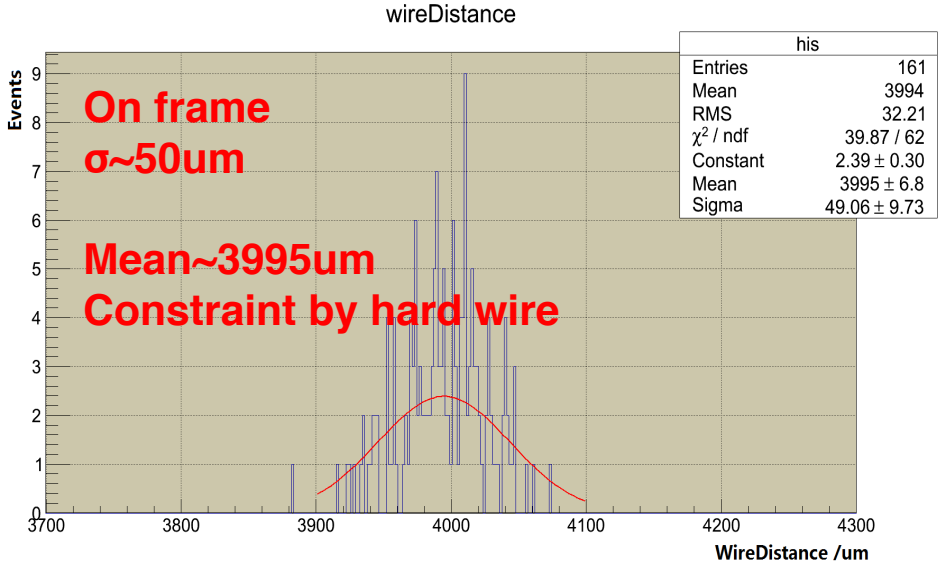
Measure the pitch of wires using the same laser system

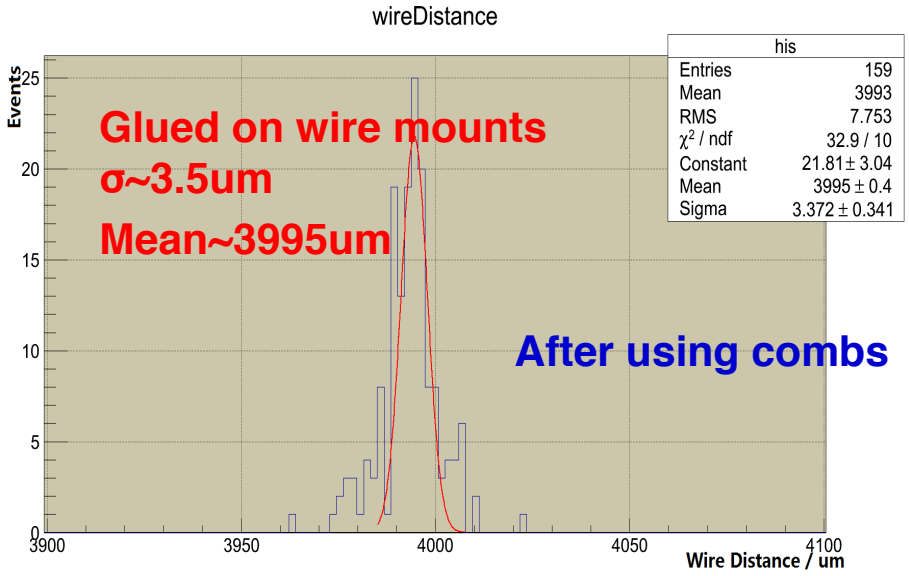
- **Focusing the laser on each wire, width of response is the wire diameter**





- **Distance between wires :**

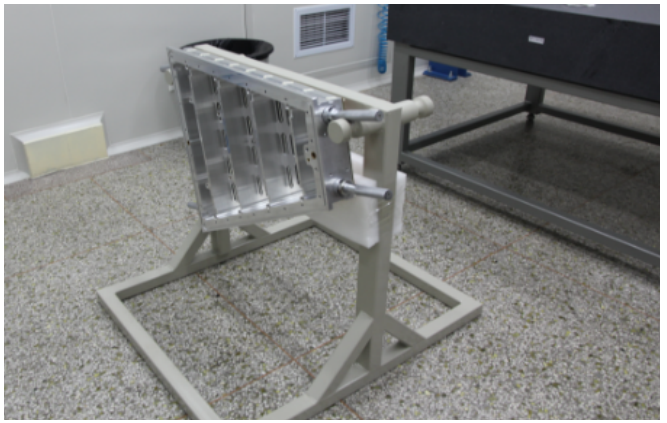




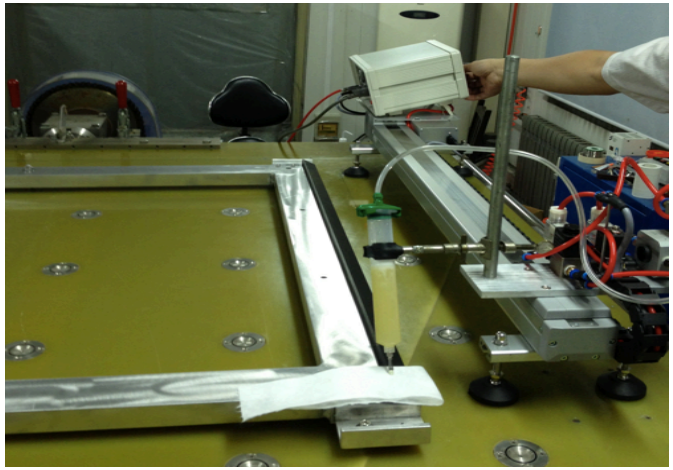
Tools & fixture designed during prototyping

- **Started the full size iTPC prototyping since September 2014. Several tools haven been made since then.**

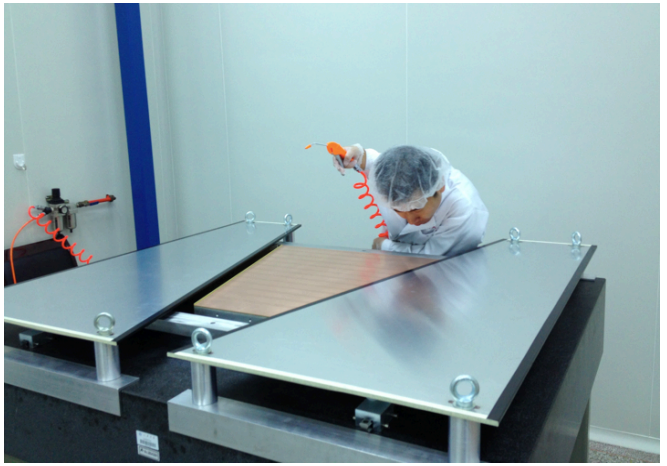
Drill/pin fixture



Gluing stand (anode WM)

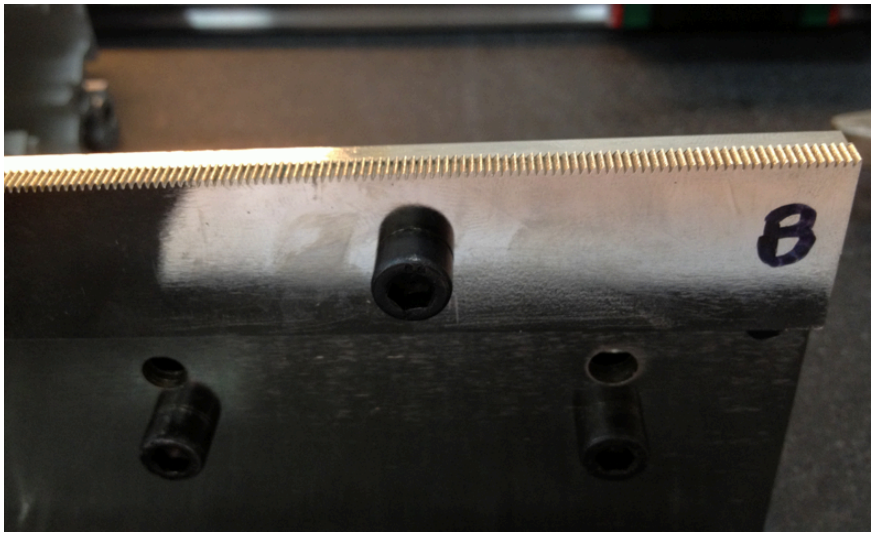


Gluing machine



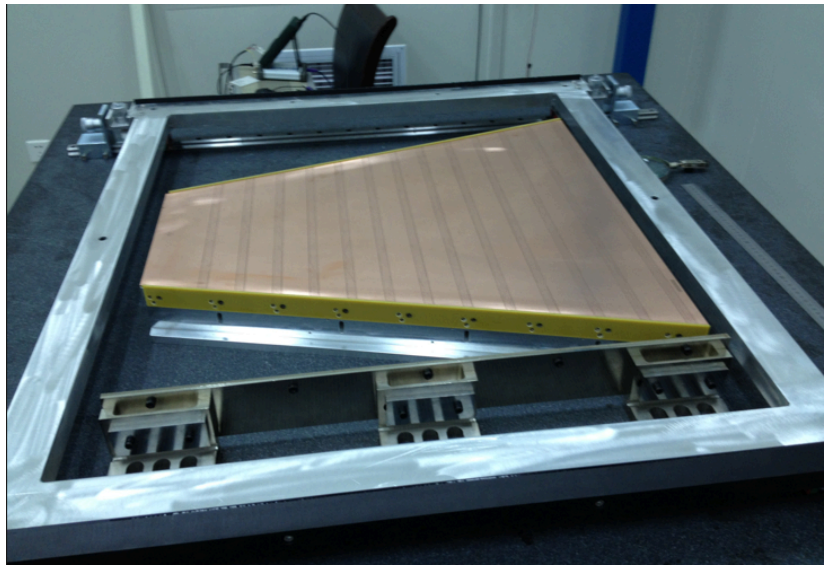
Protecting cover

Wire combs to keep wire pitch and height



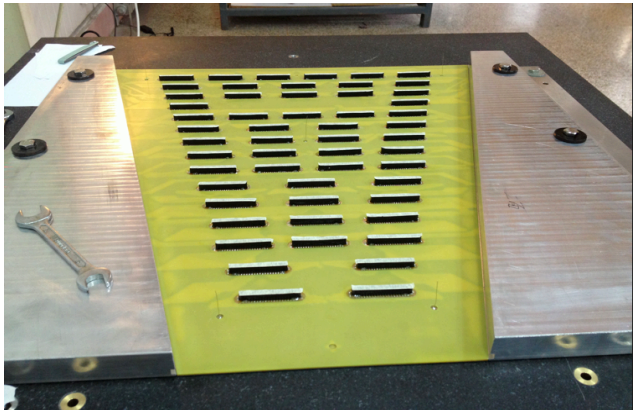
- Wire pitch and height is controlled by wire comb as originally used in STAR TPC.
- The flatness of straight edge should be <10um.
- The combs produced by LBL will be used.

- Mounting wire combs using height standard (tolerance <10um) and micromete(1um).
- Lowering down the frame to let the wire just touch the comb straightedge using micrometer head.

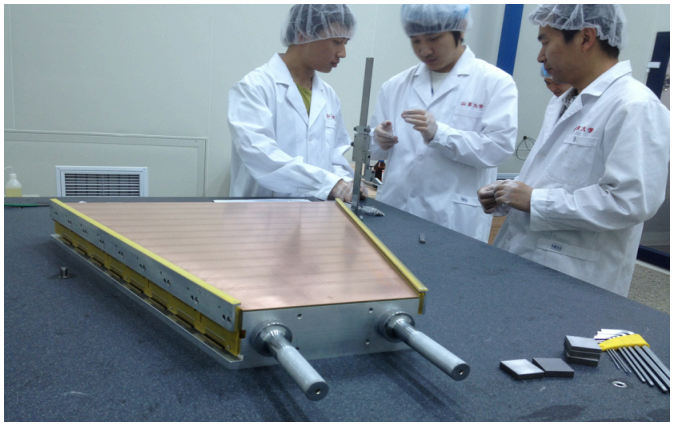


Full size sector prototyping at SDU

- **Started the full size iTPC prototyping since September 2014.**

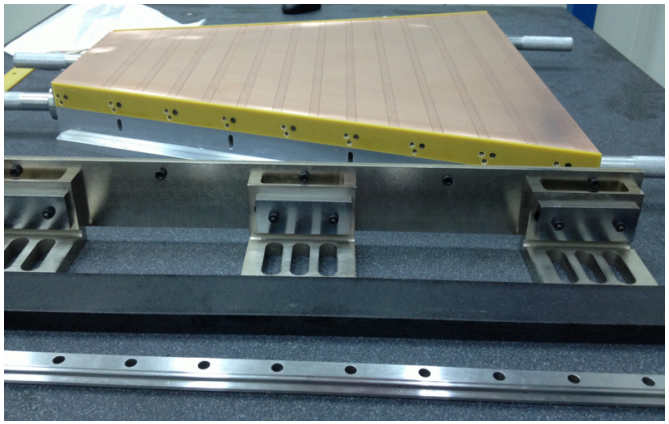


PCB bonding



Side wire mounts

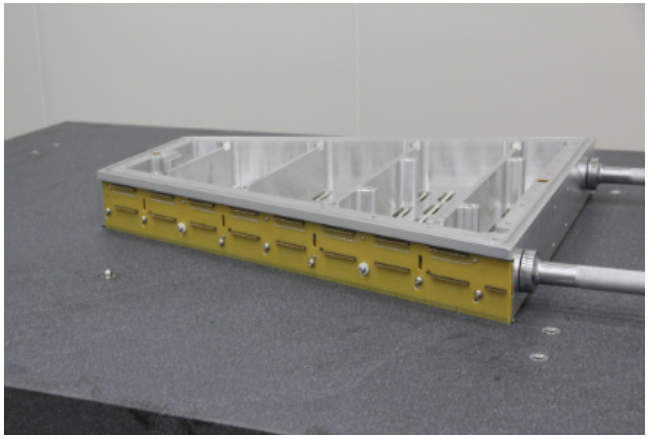
Pinning station for wire mounts



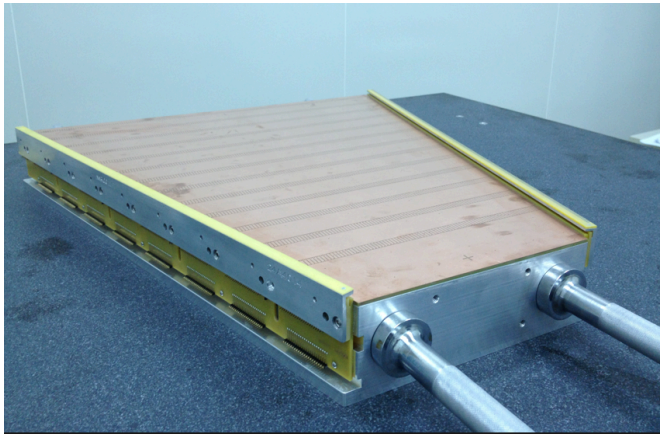
Wire combs

Install the shield & gated wire mounts

Install the shield and gated wire mounts using spacers and tighten them while keeping wire mounts resting on granite table tightly.

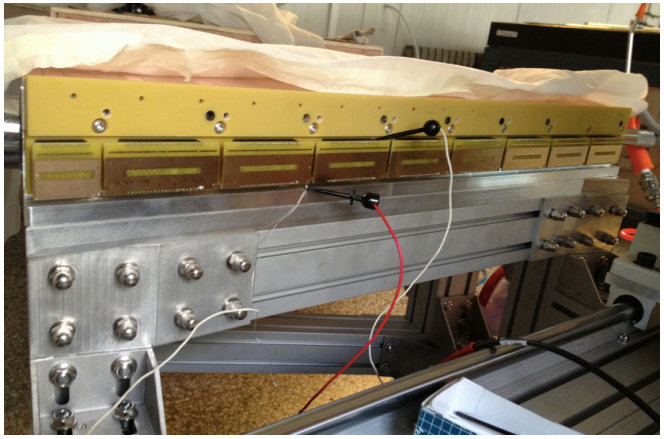


Shield Wire mount



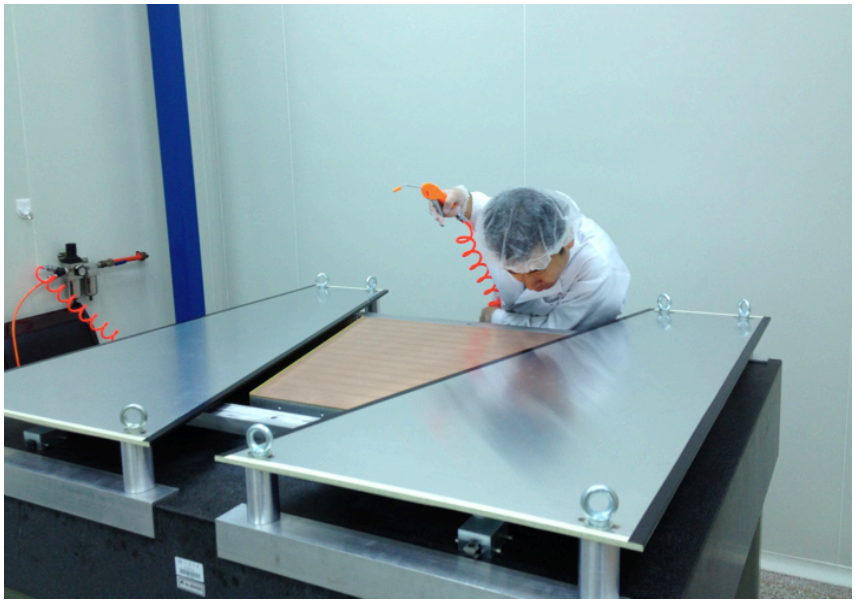
Gated Wire mount

Drill/pinning



Leakage current, continuity, open test

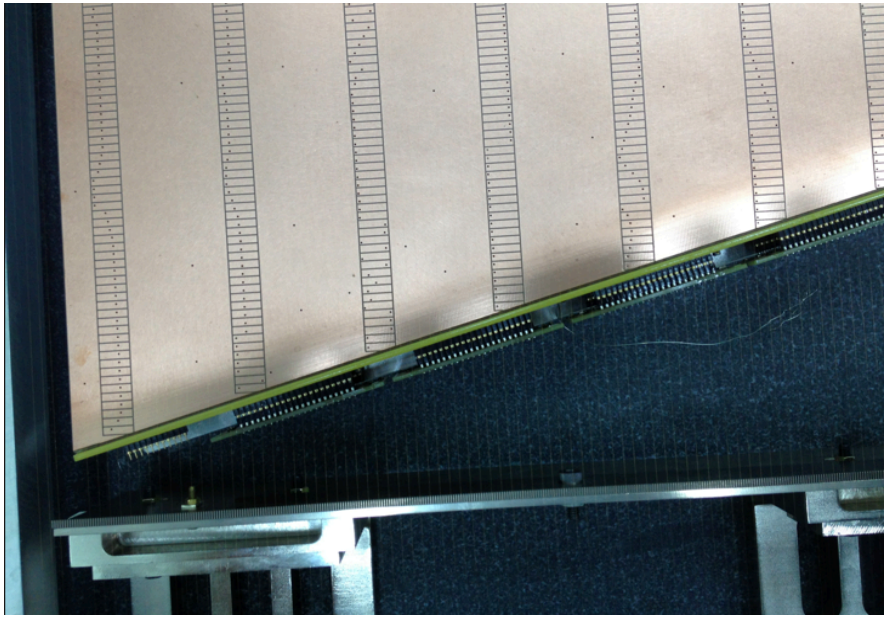
Mounting the anode wires



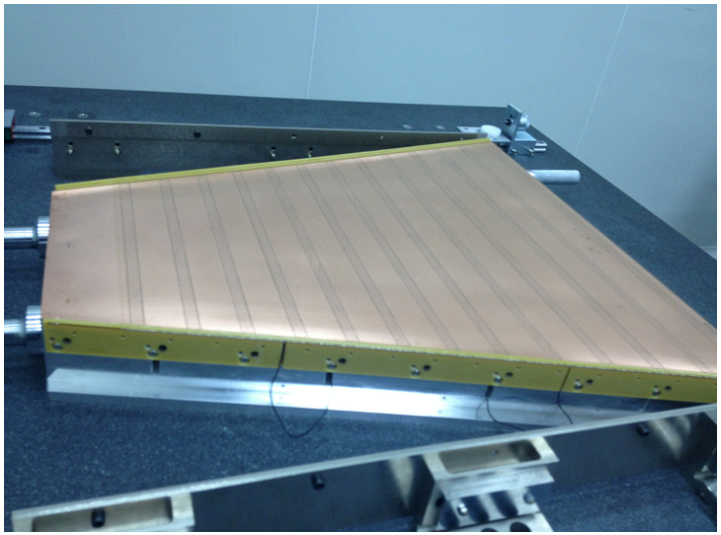
Mounting the protecting cover

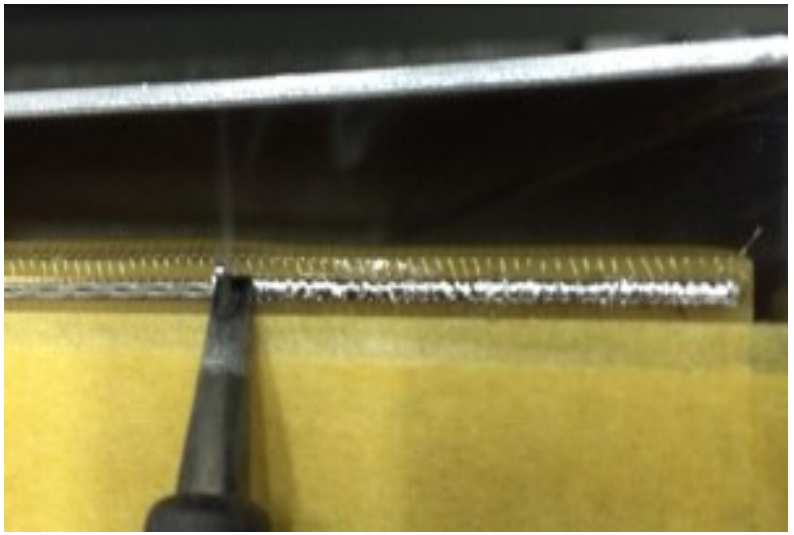
Adjusting the gluing robot

Soldering the anode wires

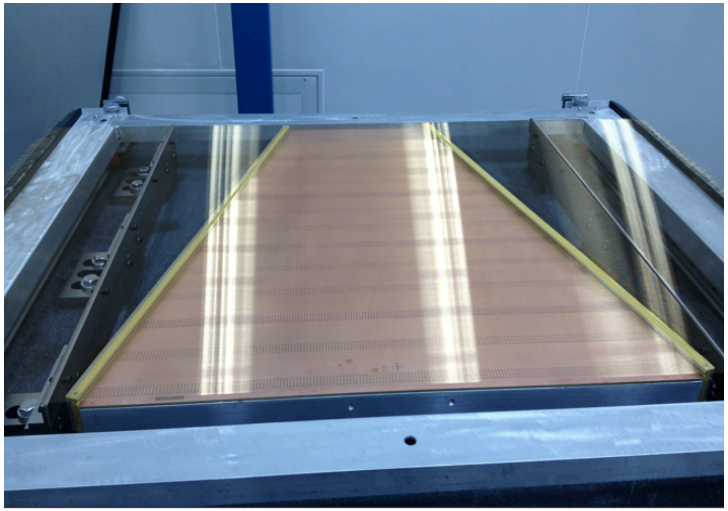


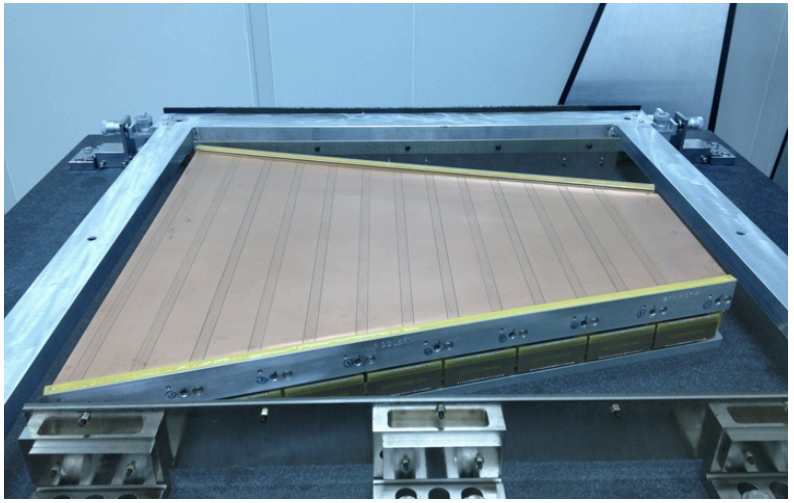
Mounting the shield & gated wires





Shield wire epoxied and soldered



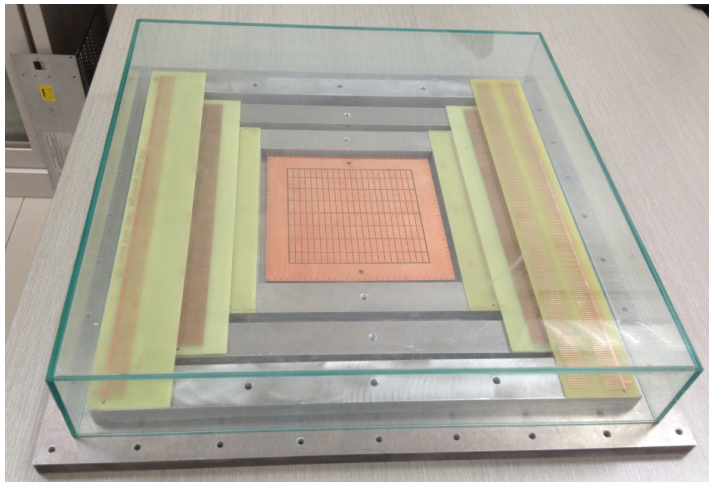


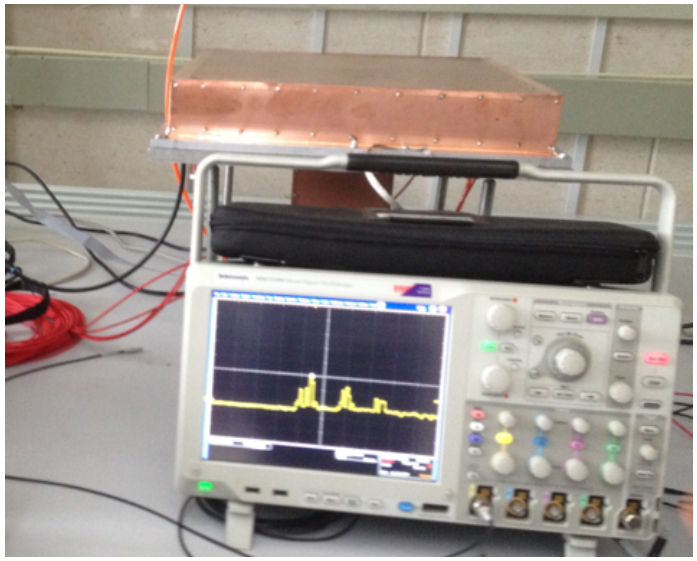
Gated wire epoxied

Small MWPC prototype and test with cosmic system (2014)

Cosmic ray test system

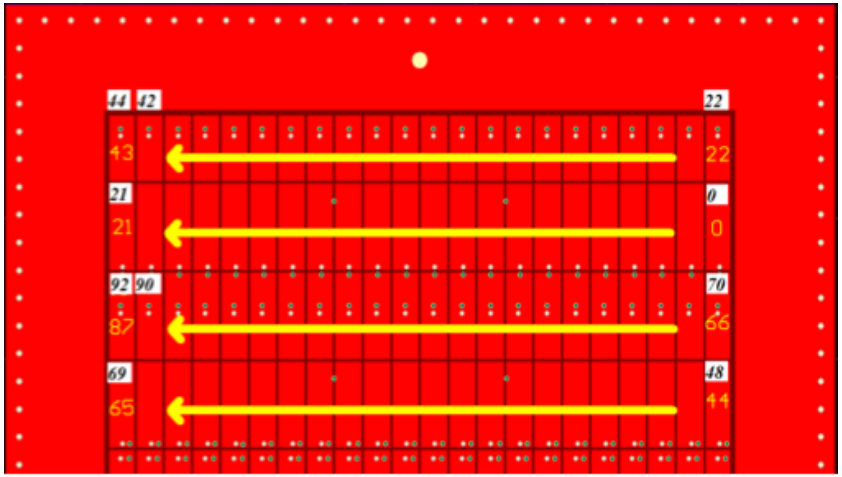
Dimension 50x50x10cm, similar structure as iTPC



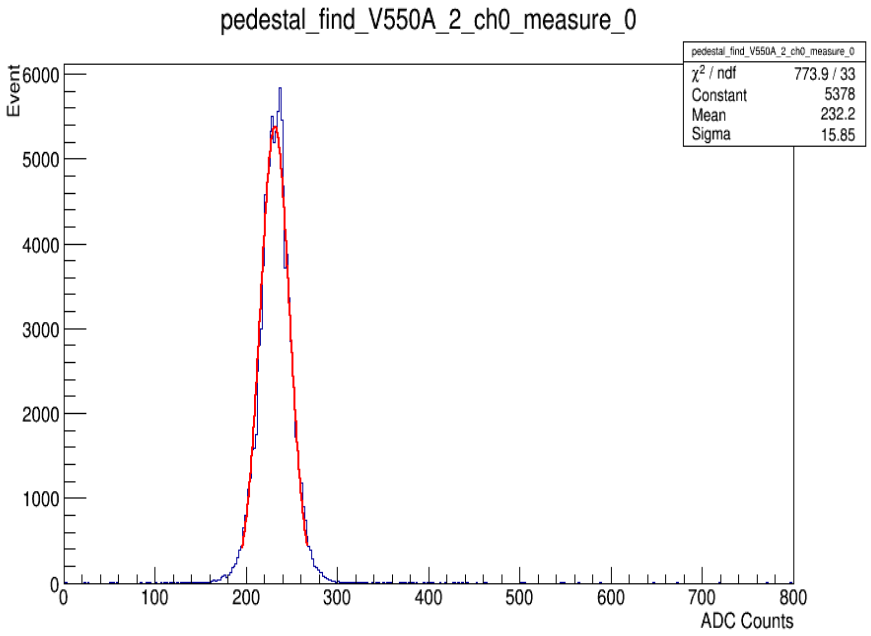


Test results of small TPC (2014)

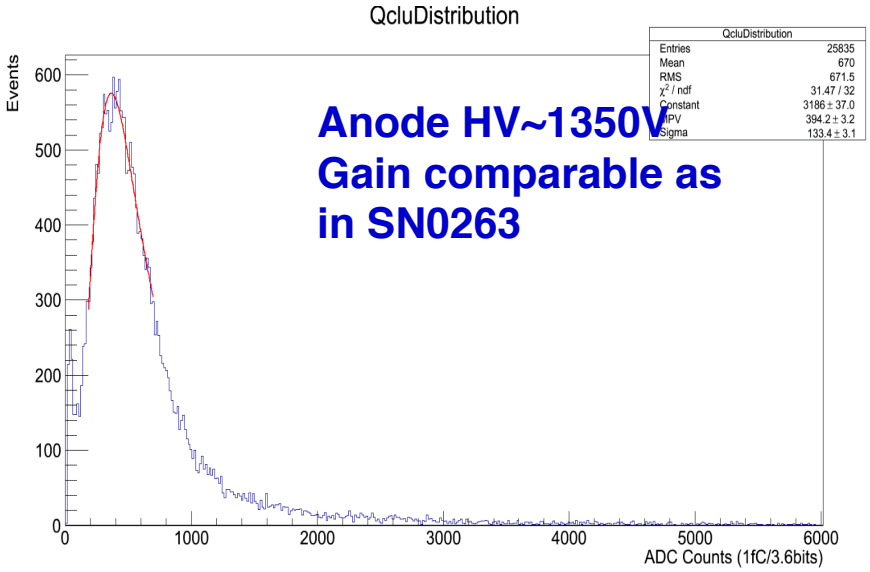
- **Now only reads out the charge of 88 pads of 176 in total with simple electronics (one V550A board), without time information.**



- **Pedestal seen for the charge of single pad**



- **Signal after subtracting pedestal**

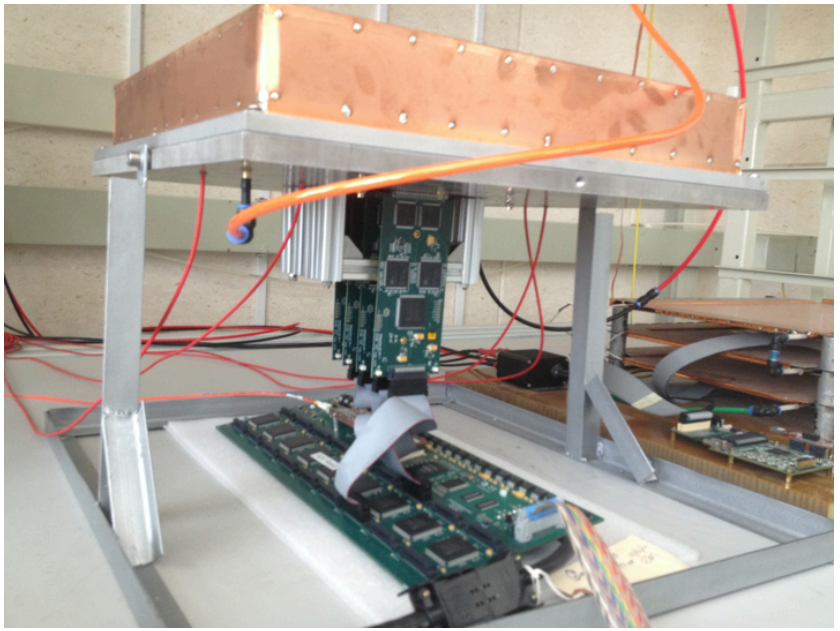


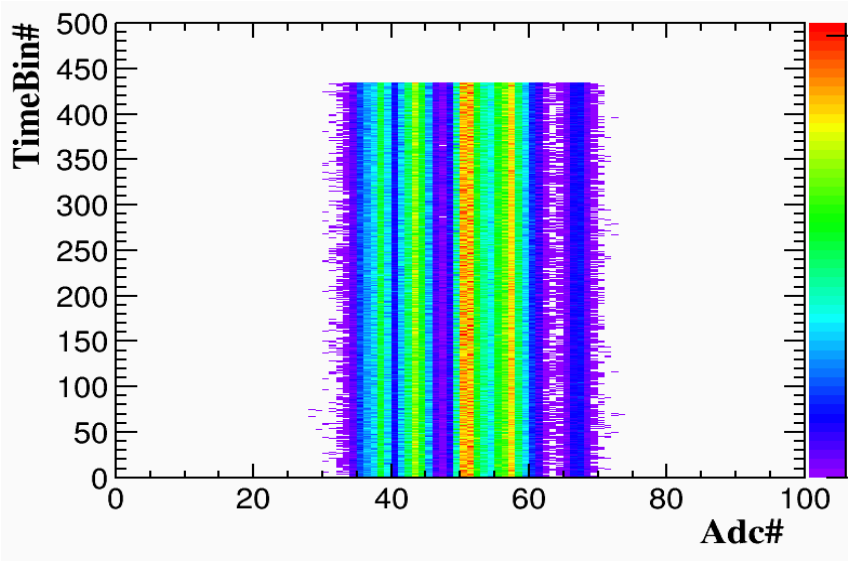
New Test with STAR DAQ system (2015)

- **Whole DAQ set obtained from BNL in Feb: Fee card, RDO board, TCD, PCI card**

- **Control PC configured by Tonko Ljubicic, the whole DAQ setting up is almost ready for data taking.**

- **1st test file with random triggering (pulser), taken by Tonko Ljubicic in Aug.**





Production plan & schedule

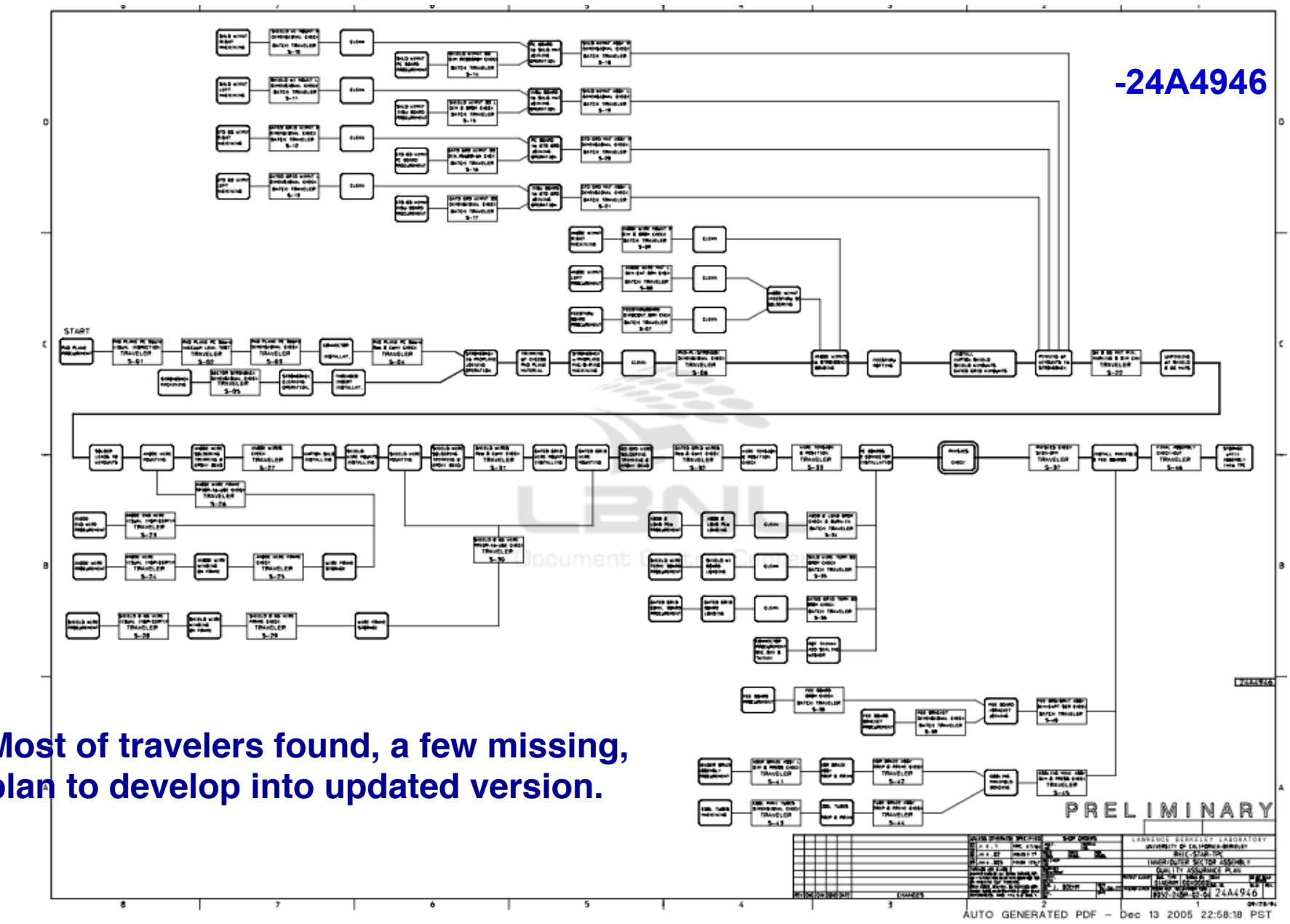
3.4	**MWPC**	**578 days**	**Thu 10/9/14**	**Fri 1/20/17**
3.4.1	**Protype Planes**	**40 days**	**Mon 12/15/14**	**Fri 2/6/15**
3.4.1.1	Procure material	30 days	Mon 12/15/14	Fri 1/23/15
3.4.1.2	Wind Planes	10 days	Mon 1/26/15	Fri 2/6/15
3.4.2	**Production Planes**	**578 days**	**Thu 10/9/14**	**Fri 1/20/17**
3.4.2.1	procure material	30 days	Thu 10/9/14	Wed 11/19/14
3.4.2.2	Wind Planes 6 sectors	30 days	Fri 7/22/16	Thu 9/1/16
3.4.2.3	Wind Planes 6 sectors	30 days	Fri 9/2/16	Thu 10/13/16
3.4.2.4	Wind Planes 6 sectors	30 days	Fri 10/14/16	Thu 11/24/16
3.4.2.5	Wind Planes 6 sectors	30 days	Fri 11/25/16	Fri 1/20/17
3.5	**Assembly**	**962 days**	**Thu 10/9/14**	**Thu 7/26/18**
3.5.1	Setup assembly facility	5 mons	Thu 10/9/14	Wed 2/25/15
3.5.2	Setup Testing facility	150 days	Thu 10/9/14	Wed 5/6/15
3.5.3	Assemble Prototype	5 days	Fri 6/3/16	Thu 6/9/16
3.5.4	test prototype	30 days	Fri 6/10/16	Thu 7/21/16
3.5.5	Sector Prototype tested	0 days	Thu 7/21/16	Thu 7/21/16
3.5.6	**Production**	**388 days**	**Tue 1/17/17**	**Thu 7/26/18**

Production plan & schedule

Sector arrival from LBL

3.5.6	Production	388 days	Tue 1/17/17	Thu 7/26/18
3.5.6.1	Assemble with MWPC	90 days	Tue 1/17/17	Mon 5/22/17
3.5.6.2	Test	84 days	Mon 2/6/17	Thu 6/1/17
3.5.6.3	Ship to BNL	20 days	Fri 6/2/17	Thu 6/29/17
3.5.6.4	First 6 modules at BNL	0 days	Thu 6/29/17	Thu 6/29/17
3.5.6.5	Assemble with MWPC	90 days	Tue 5/23/17	Mon 9/25/17
3.5.6.6	Test	84 days	Mon 6/12/17	Thu 10/5/17
3.5.6.7	Ship to BNL	20 days	Fri 10/6/17	Thu 11/2/17
3.5.6.8	Nextt 6 modules at BNL	0 days	Thu 11/2/17	Thu 11/2/17
3.5.6.9	Assemble with MWPC	90 days	Tue 9/26/17	Mon 2/12/18
3.5.6.10	Test	84 days	Mon 10/16/17	Thu 2/22/18
3.5.6.11	Ship to BNL	20 days	Fri 2/23/18	Thu 3/22/18
3.5.6.12	Next 6 modules at BNL	0 days	Thu 3/22/18	Thu 3/22/18
3.5.6.13	Assemble with MWPC	90 days	Tue 2/13/18	Mon 6/18/18
3.5.6.14	Test	84 days	Mon 3/5/18	Thu 6/28/18
3.5.6.15	Ship to BNL	20 days	Fri 6/29/18	Thu 7/26/18
3.5.6.16	Last 6 modules at BNL	0 days	Thu 7/26/18	Thu 7/26/18

Original QA plan for assembly- flow chart with travelers



Most of travelers found, a few missing, plan to develop into updated version.

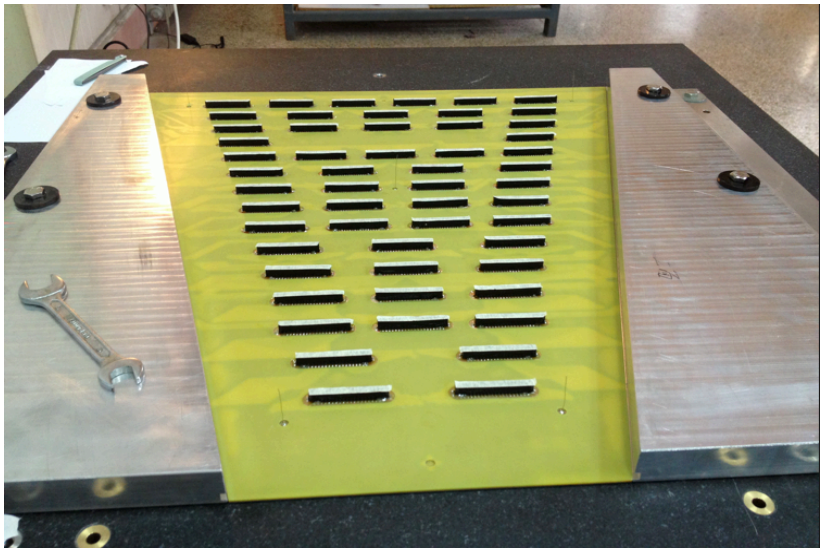
Summary

- Funding secured for prototyping and production of MWPC.
- Wire tension measurement system designed & tested.
- The 1st pre-prototype just finished. The setup of test/DAQ system is underway.
- Related tools & fixtures for production designed. Wire combs will be reproduced at LBL.

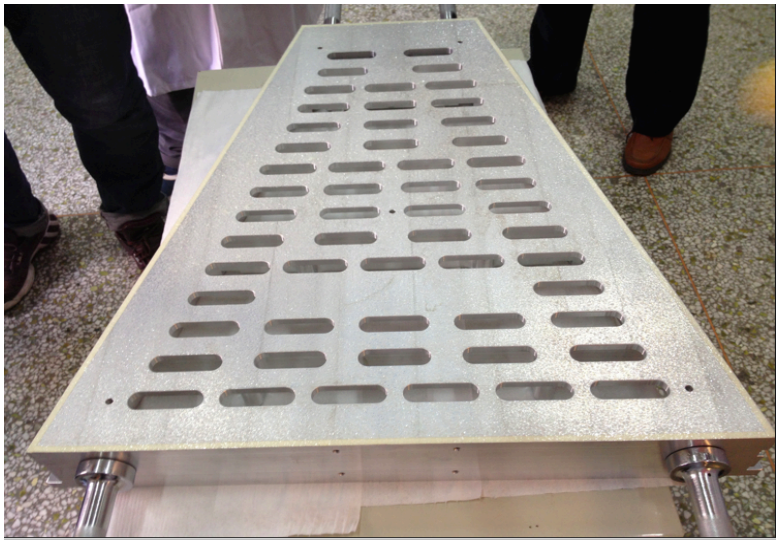
  Soldering table is being designed.

  The production will be ready in summer of 2016.

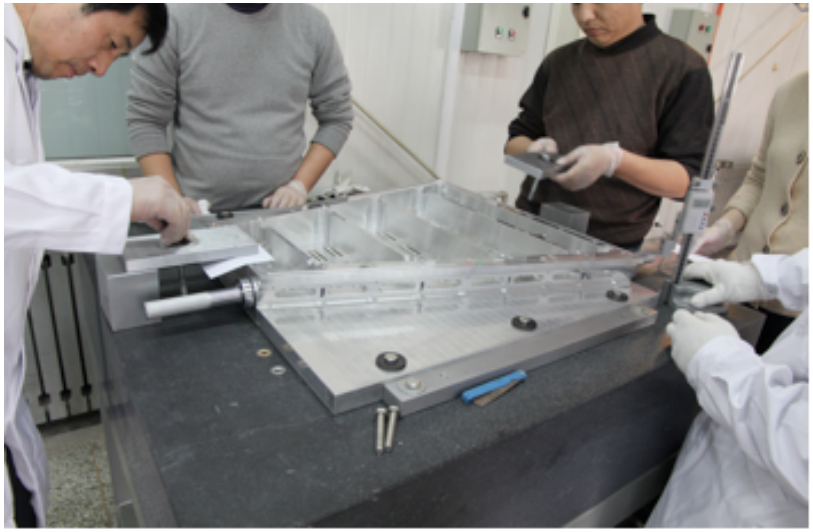
PCB bonding (Will be done at LBL for production)



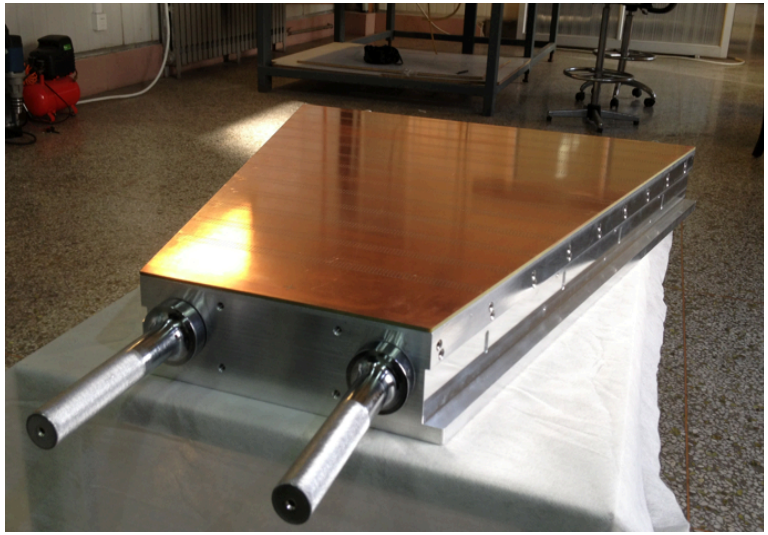
Pad plane vacuum tight to granite table



Expensing epoxy to strongback



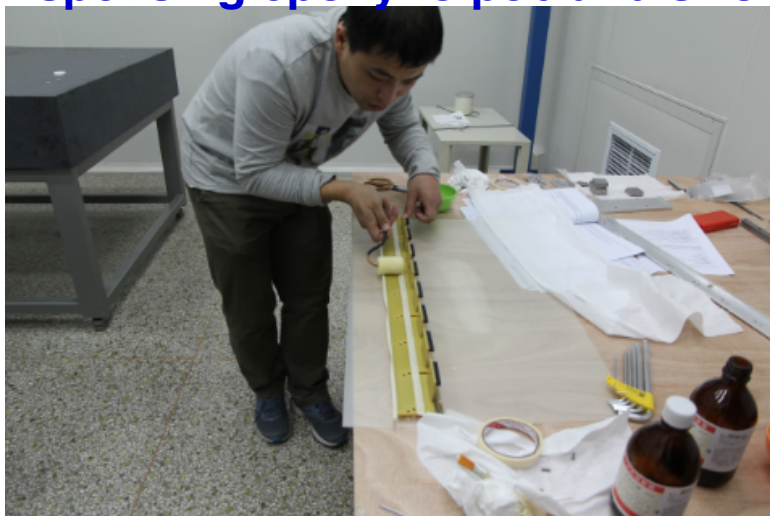
Lower strongback to pad plane



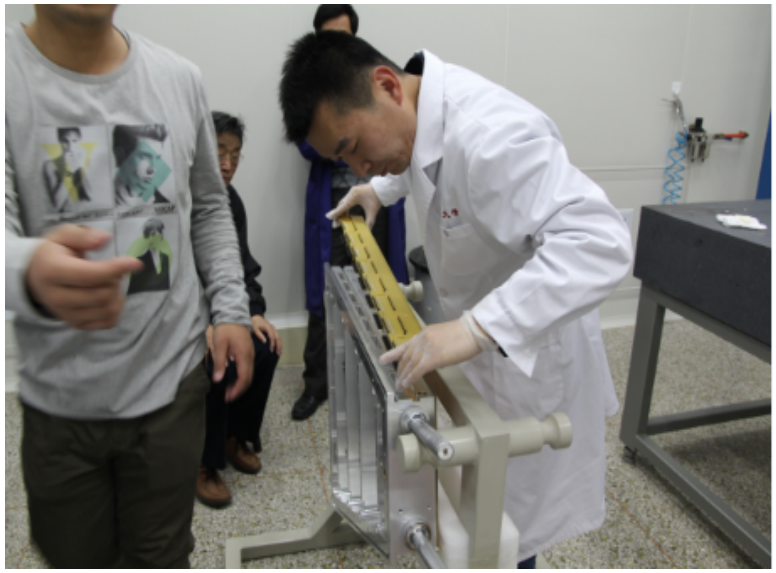
Let the epoxy cure for 40 hours

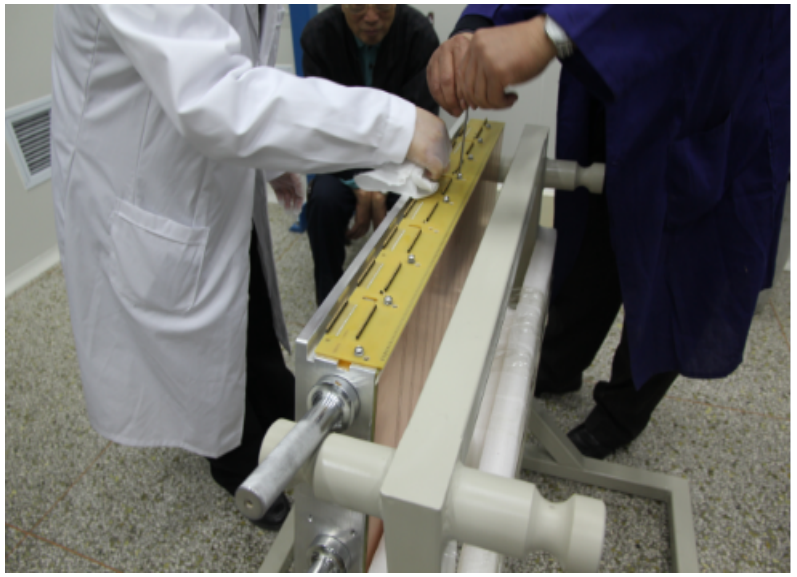
Epoxying the anode wire mount (1)

- Dispensing epoxy to pcb and strongback



- Put wire mounts in place with screws





Epoxying the anode wire mount (2)

Put the strongback on granite table over 4x1.85mm spacers, pad plane facing down, positioning plate on the narrow end.